"Geospatial data collection policies, technology and open source in websites of academic libraries worldwide"

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Abstract

The proliferation of geospatial data demands the engagement of information organizations, such as academic libraries, for their management and diffusion.
The purpose of this paper is to reveal issues related to the development of geospatial collections and explore their efficient use as required by the current information environment. Thus, a research conducted on 363 websites of academic libraries worldwide and 136 websites maintaining geospatial collections were identified. The research questions were formed based on international bibliography and we applied a content analysis method for data extraction. Findings show a significant activity of academic libraries in providing GIS services in accordance with high rates in user education programs, creating the use of geospatial collection and Geographic Information Systems (GIS) services more effective. Nevertheless, through their websites we obtained poor response to communicate geospatial collections policies. The majority of the academic libraries surveyed in this study provide commercial software to their users for managing data on a local level, while the minority of library patrons are able to use geospatial data via remote access. This paper explores aspects of development in geospatial collections in academic libraries that have not been adequately raised. Additionally, we provide an overview of geospatial collections worldwide.

Keywords: *geospatial collections, collection development policy, open source, GIS, academic libraries, technology, websites surveys*

INTRODUCTION

Academic libraries have reached a crossroad in terms of collecting, evaluating and managing resources (Borin & Yi, 2008). Changes occurring in technology, budgeting, scholarly communication and publishing have changed and redefined libraries' collections (Nabe, 2011). At the same time libraries as dynamic organizations, are trying to expand their services in a global level, to meet the growing needs of their users.

Collection development based on locally produced scientific data creates new challenges for librarians such as building or strengthening their relations with faculty and research centers/laboratories in the academic community; effective collection development will expand the services that can be offered by the library (Newton e.a., 2010). Geospatial data are also included in the enormous amount of data produced in different fields of what is called "Big Data". Geospatial data are statistically significant since their quantitative nature and results point towards qualitative significance as they represent almost 80 percent of public sector information[1]. Furthermore, production, procurement, and updating costs for geospatial data are high while the annual public expense for activities related to these in U.S. exceeds $4.4 billion (Koontz, 2003).

Academic libraries in the past played a significant role in the campus wide organization and accessibility to geographical collections (Larsgaard, 1998). It was the ARL (Association of Research Libraries) GIS Literacy Project in U.S. that enabled the widespread diffusion of digital geographic information in academic libraries through technological support and librarians' education (Howser & Callahan, 2002). Geospatial data are unique and their process requires advanced, sophisticated software and hardware. The creation of a strong written policy can be an assisting tool for the librarian in the collection of data produced by scientific personnel and stakeholders in an institution. This management practice aims to the formulation of a digital geospatial collection and GIS services. In this context the development of a research data collection created by an academic institution -with the inclusion of geospatial data- is a standard practice for some libraries or a strategic goal for others. Many libraries, in order to accomplish this goal are using open access channels. Additionally, their collection development is based on approved written policies, generated as a result of the in-depth study of the organization (e.g. Queensland University of Technology, Brisbane Australia)[2]. Thus, new grammar for information management is generated and new opportunities are created for providing services aiming to adjust libraries in the new information environment along with meeting the growing needs of users.

As Stevens (1997) argues the World Wide Web is an attractive mean of enhancing the service capabilities of academic libraries. It is also an uncharted service landscape presenting significant challenges in the development of effective services and resources.

The purpose of this paper is to explore whether in today's information society in which geospatial information is essential for citizen's everyday life, libraries with geospatial collections have adopted some key factors for promoting the geo-information through their websites to their patrons. In the context of this research these factors are: *geospatial collection development policies, technological infrastructure and GIS services, remote access, user education and the use of open-source software.*

To answer the above, we conducted an initial research to websites of academic libraries with geographical collections serving departments where geographic information is essential to the educational and research process.

Our research is different from other similar research both in terms of geographic coverage, and the examined factors that, according to the relevant literature, affect the development and utilization of geographical collections while they offer services for a more efficient user access. Our research is quantitative and the findings will update the current information for geospatial collections worldwide.

One reason why we conducted this research study is that even though Greece provides open geospatial data of the public sector[1], a variety of limitations have prevented Greek academic libraries from achieving similar growth in GIS services with other academic libraries abroad (Vardakosta & Kapidakis, 2011). We expect our findings to assist researchers into further investigation of the examined factors and contribute to the formulation and creation of an effective tool for librarians and other stakeholders who work on the development of these collections. In our paper the reader will find a section with definitions of the topics of interest, the conceptual framework, literature review including past studies on the subject, the methodology applied and the data collection process. Our findings, a discussion and conclusions, and future works are found in the last section of the paper.

DEFINITIONS

The implementation of standard World Wide Web technologies, digital gazetteers, and special attention to metadata use combined with the extensive distribution of "user friendly" software, expanded the potential for geospatial analysis use by many disciplines (Hill, 2000; Steinhart, 2006). As a result, over the last few years major academic libraries (e.g., Cornell[3], Harvard[4], and Stanford[5]) with a tradition in digital collections, have developed collections of geospatial content and interactive services. Thereby these major libraries provide additional services to patrons. Geographical information may exist in an optical form (e.g., maps, remote sensor images, photos, etc.) or in a textual form (e.g., fieldwork descriptions, technical documents and reports) (Borner & Chen, 2002). A geographical collection consists of materials such as books, journals, maps, atlases, aerial photos, remote sensing images, geospatial data, software, etc., all of which involve the study of human impact on the earth. As any success in geographic information delivery and consumption is intrinsically linked to the medium on which it is created and displayed (Hurst & Clough, 2013), so these libraries collect different types of digital data such as aerial views, atlases, data series, remotely sensed images, city foreign maps, topographic profiles, etc. Subject categories that libraries offer to their patrons include both physical and human geography. The most frequently used formats are CDs, DVDs, and raster data but microforms, CD-ROMs and vector data are selected as well (Vardakosta & Kapidakis, 2012).

In the last decades international bibliography demonstrates Collection Development Policies (CDPs) that have been typically characterized as *"tools*" (Bostic, 1988; Wood & Hoffmann, 1996),*"a contract between the library and its users"* (Gorman & Howes, 1989), *"an educational tool for the new personnel"* (Jenkins & Morley, 1999, p. 8), "*the vehicle through which the library will achieve its goals regarding provided service,*" or "*the guide to the library sources for the academic community"* (Olatunji Olaojo & Akewukereke, 2006) while for Johnson (1994) "*libraries without policies are like companies without a business plan."*

Jenkins (2005) argues that "*posting CDP on the library's website is an easy way to make it available*".

In the world of digital libraries, a policy is typically described as a condition, term or regulation governing the operation of a digital library or some aspect (Innocenti e.a., 2010). An important step in data collection (that have been produced by the scientific personnel of the institution in order to organize and develop a digital geospatial collection and GIS service), is the creation of strong written policies.

The use of spatial data is carried out and is completed through Geographic Information Systems (GIS). GIS can be considered as "a technology-based computational system for the collection, management, analysis, modeling and presentation of spatial data for a wide range of applications" (Davis, 2001, p. 13).

Essentially, GIS combine five components: people, data, software, hardware and methods for finding solutions in issues with geospatial content. However, GIS are basically designed for production needs rather than the retrieval needs of a metadata system (Antonelli, 1999). For Adler and Larsgaard (2002) the type of the library (e.g., public, academic, research) is among the elements that defines and differentiates the provided service levels. Boisse & Larsgaard (1995) and Kowal (2002) divide GIS provided services in three levels: *a) introductory*, *b) mediate*, and *c) advanced;* while Howser & Callahan (2004) identify GIS services as: "*access to GIS software*, *scanner*, *photocopiers*, *guides*, *data*, and *technical support"*. Furthermore, the same researchers point out that when the above service levels are supplied by libraries, they represent a typical example of successful service implementation. For the needs of the present study the above definition for GIS services was adopted.

Lately, GIS seems to gain ground due to the open-access movement and the open software in the field of information (for access and distribution) (Corrado, 2005; Lewis, 2012). Public sectors around the world organize their services using open systems and encourage their use (de Montcheuil, 2012). Libraries, as institutions of information dissemination and enforcement of new technologies, are leading organizations in the adoption of open systems like: Open Office, or Zotero for bibliographic management; Linux for servers administration; Evergreen and Koha for library's automated system (Ritterbush, 2007; Bisson & Eby, 2007; Chudnov, 2007) or Dspace, Fedora and e-prints for repository's needs (Little, 2013). As developments in information environment direct the library to the role of information retrieval and dissemination facilitator (Wulf, 1995), it should find ways to organize its content in whatever form it might have (Billings, 1997).

Remote access is a new approach to offering services, without local or time constraints, providing the library the ability to control and examine statistical data through policies that will be created. Since remote access is an infrequently discussed factor in literature related to geographical information that libraries organize and provide, its final contribution to an efficient use of sources and data, enables its further exploration.

CONCEPTUAL FRAMEWORK

The prime concern of academic libraries is to provide relevant digital information aligned with the needs and priorities of the universities they serve. (Sennyey e.a., 2009). Especially in institutions with departments/sections covering geosciences (geology, physical geography, geophysics, soil science, oceanography, glaciology, etc.) or environmental sciences (ecology, biology, etc.) libraries should have acquired the appropriate materials, in both paper and digital format, for faculty and students to use them. These local communities rely on this kind of information as

a main source for covering their informational needs. Recently, the diffusion of scientific and research data with geospatial content have challenged librarians, due to the interdisciplinary nature of geographical information.

CDPs have always been a tool for the librarian in the collection development of the library, as well as the communication point toward a number of stakeholders (users, administration, institution members, and other libraries/organizations) regarding library collections. The evolution of technology and the dissemination of information, combined with the characteristics of geospatial data, call for a need to redefine policies in order to align with the current digital environment. Additionally, budgets of academic libraries are shrinking as a result of the global financial crisis. In this context, the open-access movement is an opportunity to utilize data derived from scientific research or the internet, and take advantage of open software in order to provide value-added services.

The nature of geospatial data focuses on the visualization of information transferred via the appropriate software and generating new datasets, which are accomplished through the ability to use technological infrastructure (workstations, scanners, GPS, etc). Strongly linked to technology, remote access serves the need for constant access to the information, without time and geographical constraints.

Help to patrons expressed by user education programs, tutorials, guidelines etc., will increase their ability to utilize this kind of information and technology for their educational and research activities.

In Fig.1 the model schematically analyzes the concept of geospatial collection development policies in a library setting, its influence in the development of geospatial collection and its interaction in the establishment of GIS services. Thus, we argue that academic libraries use geospatial collection development policies in order to collect several types of data (such as research, commercial and open) and develop their collections. The GIS services that the libraries provide to their users include both technological infrastructure and instructions for the different uses of data and the different patrons' requirements. These services offer significant benefits for the users and are essential to the efficient use of the collections. Patrons are using the wealth of information that libraries provide in order to create new knowledge. This knowledge, through various channels (such as scholarly publications, journal articles e.t.c.) will finally return to the libraries and shape their collections.

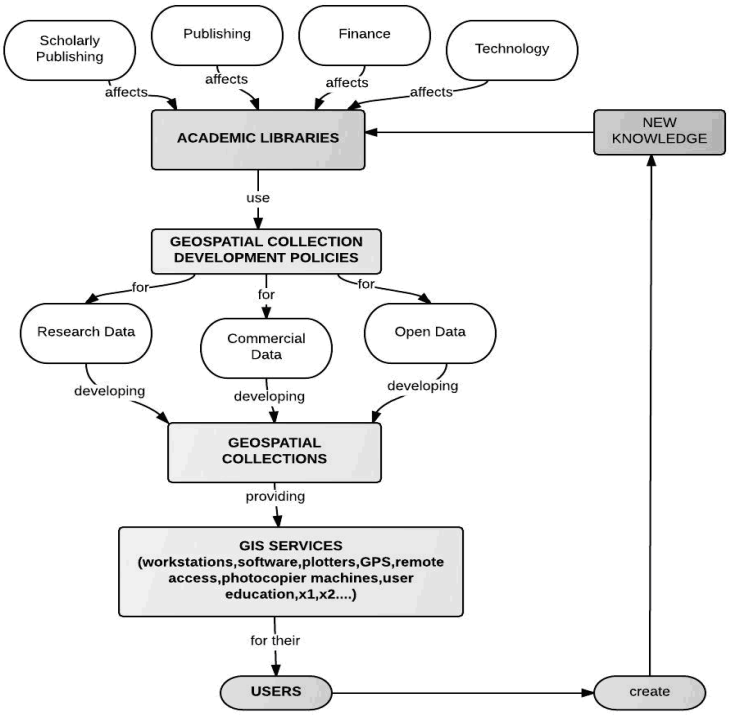


Fig.1: Conceptual framework of the study

LITERATURE REVIEW

As soon as the ARL project was completed, the literature associated to GIS increased (Michalec & Welsh, 2007). Many surveys are listed on how many libraries have geospatial collections (Good, 2009) or have cancelled their GIS services (Wangyal Shawa, 1998). However, these surveys are geographically limited in the countries the surveys took place, and in libraries that were members of the ARL (Davie, 1999; Kinikin & Hench, 2005; Kinikin & Hench, 2005a) (see Table 1). An examination of geospatial collections in academic libraries worlwide distinguishes our research and adds new evidence. CDPs issues provoke common belief for researchers and professionals despite the variety of material (Little, 2011) or the way that information disseminates, e.g., electronic resources (Sanchez Vignau & Presno Quesada 2006; Mangrum & Pozzebon, 2012). The formulation of geospatial CDPs is a necessity as Longstreth (1995) in his early writing in the field indicates, and this conviction is highlighted in literary studies (Boxall & Anderson 2005; Boxall, 2006; Abresch e.a., 2008 p. 212). Nevertheless, it has not been reflected in any of the surveys carried out in this field. We aim to cover this gap with the findings of our research.

In the creation of a GIS CDP, library professionals should consider the established collection development policy, the needs of the users, GIS services and library infrastructure (Florance, 2006). As a consequence, the technological infrastructure that libraries provide for the use of geographical data that have in their collection and the software used, have been investigated in the past (Garza, 2006; Sorice 2006; Gabaldon & Replinger, 2006). Our research responds to Donnelly's (2010) assertion that there is not enough research data for the use of open GIS systems in libraries.

The potential of remote access to geospatial collection is an issue directly related to the technological infrastructure held by the library. New sets of user's demands and technological challenges provoke libraries to adapt new approaches for

facilitating the access to geospatial data. The exploration of the open source software will contribute to that direction since it is an aspect that was not addressed sufficiently for academic libraries with geospatial collections worldwide.

Library website has been part of the user's journey to library resources for years (Little, 2012). These websites provide a connection to the collections and a general picture of their purpose and role within a larger organization (Lewin & Passonneau, 2012). Innocenti e.a. (2010), argues that «*users need to be aware of the policies and trained in using the collection*». Distinguished professionals and researchers involved in the implementation of GIS services from libraries, annotate in their works the inseparable link of data, infrastructure and education to the end user (Lamont, 1997; Sweetkind-Singer & Williams, 2001; Gabaldonn & Replinger, 2006). This training varies and can take the form of instructions, tutorials or organized seminars for patrons.

In summary, our research differs from other similar surveys on: a) the range of the sample, b) the geographical range, and c) the quantitative investigation of issues such as geospatial CDPs, remote access to geospatial collections and the use of open software.

RESEARCH QUESTIONS

The research question guiding this initial research was: "*do libraries use their websites to utilize some key factors to promote the geospatial information and the delivery of appropriate GIS services in today's information society?*" In order to answer it we formulated the following secondary questions:

RQ1: Do libraries that support education and research in sciences like geography, environment etc sustain geographic collection and consequently GIS services?
RQ2: Do academic libraries sustain CDPs for geospatial data?
RQ3: Are technological infrastructure and user education provided?
RQ4: Have academic libraries been adapting to the use of open source software?

METHODOLOGY

RESEARCH METHODS

In this study, we examine academic libraries because of their:

- quantity and wideness: academic libraries support a wide part of libraries and librarians society,
- reliance on new technologies,
- history in the implementation of GIS services (e.g. ARL GIS Literacy project in 1992),
- services to a wide range of users with diverse needs and interests,
- traditionally structures, standards, rules and restrictions both for operating (e.g. policies) and managing the information,
- refinement or creation of new services for meeting their users needs,
- traditional gathering of the intellectual production of their institution,
- cooperation with the scientific community and
- information process about the open-access movement.

The research methods we applied were:

a) *the investigation of official websites of academic libraries*,
b) *quantitative content analysis*.

The widespread use of the above two methods both in surveys related to libraries in general (Wang & Gao, 2004; Detlor & Lewis, 2006; White & Marsh, 2006; Bennett & Nicholson, 2007; Kim & Decoster, 2011), and to those relating to geospatial collections and GIS services in particular (Stephens, 1997; Kilfoil, 2002; Sorice, 2006; Weimer, 2012; Nicholson & Dodsworth, 2012) was the main reason to chose it as a research method for accomplishing our goals.

CRITERIA OF THE RESEARCH

The purpose of our research is twofold: Firstly, we wanted to determine the current operating practices regarding geospatial collections, policies and services. Our goal was to collect data and disseminate information from the field, such as the impact of open source software and the remote access to the data. Secondly, the geographical expansion of the research in countries not included in previous researches can enable opportunities for further academic discussion and research on the growth of interest in geospatial data. Therefore, we chose to study 363 academic libraries from USA, Canada, Australia, New Zealand, South America, Europe, Asia, Middle East and Africa. We focused on the academic libraries that fulfil the following criteria:

a) serve departments that GIS is an integral part of education / research process and therefore provide geospatial collections,
b) GIS collections and services were developed and managed by the library itself rather than by another department, institution or laboratory and;
c) the above information is communicated to their patrons through their websites.

IDENTIFYING THE LIBRARIES

We used the "Libwebcats"[6] directory for locating the libraries needed for our research. This directory displays the various types of libraries (e.g. public, academic) by the region they were located (e.g. academic libraries of Europe, USA etc). We used this directory to choose randomly academic libraries in Australia, New Zealand, South America, Europe, Middle East, Africa and Asia. The order of the libraries in each country was not based on a factor that affects our measurements. For each region included in the research we selected a random number of libraries that fulfilled the above mentioned criteria. "Libweb"[7], which is also a directory of libraries worldwide, was used selectively for the verification of a library's website.

Our intention was for all regions to be represented by at least a single number of libraries. 363 academic libraries worldwide is considered to be a sufficient number to provide an overview for this study as our purpose was not to develop an exhaustive list of academic libraries worldwide with the above criteria.

DATA COLLECTION

The time the survey was conducted was from March 2011 to July 2011, and the methodology that we chose was divided into ***four*** stages which are hereby analyzed:

1) At the ***first*** stage, we studied the international literature to identify previous studies that had occurred in the field, the methods used, their results, etc.

Table 1: Previous researches for GIS implementation

Survey for GIS implementation in libraries	Number of Responses	GIS services implementation percentage
ARL 1999	64/72	89%
Stone-Muilenburg 2001	67/1310	5.1%
Kinikin and Hench 2005	22/138	13%
Kinikin and Hench 2005a	9 of 11	82%
Gabaldon and Repplinger 2006	31/103	31%
Garza 2006	69/100	69%
Good 2009	~90%	~90%
Vardakosta & Kapidakis 2011	95/133	72%

2) Geospatial collections consist of a certain type of information that requires the use of GIS. So, we made the hypothesis that academic libraries in universities which inter alia operate departments whose curricula are based on the use of geospatial information and GIS, e.g. Geography, Geology, Topography, Earth Sciences, Environmental Sciences, etc., *have developed geospatial collections and provide GIS services*.

Therefore, at the ***second*** stage, we investigated official websites of 363 academic libraries from several regions of the world. We are looking for those academic libraries that satisfy the first condition that we had set i.e. serve departments that GIS is an integral part of education / research process.

As visiting the official site of the library our priority was to identify whether the university sustained a department in which geographical information was essential. If such a department (e.g. Geography, Earth Sciences, Environmental Sciences, Geology etc.) existed, the specific library was included in the list. On the contrary, we were searching another library.

For the data collection, we used a spreadsheet. Library's name was written down in rows and the answers to the following questions were listed in columns:

- Library's name and official website's address
- Does the library serve an academic department related to geographical information?

We found **331** libraries fulfilling this criterion (Table 2).

3) The second criterion we set was connected to library's direct involvement in the organization of the collection/s and service/s since we had to include only those GIS collections and services that were developed and managed by libraries.

In the third stage of our research we reviewed the official webpage of the 331 university libraries trying to reach the above criterion by seeking the library's geospatial collection. For each and every one of these libraries, we visited their website and searched the link to geospatial collections and GIS services, e.g., "GIS collection/data," "GIS services," or "geospatial collection/data," or "geographical collections/data." In the spreadsheet we created, the necessary information was listed in columns. The URL of this individual site was recorded. The positive presence of the requested data was marked in each column as they had been coded. To avoid non-detection of one or more information we sought, many times we had to scroll through

numerous internal pages of the site or use the institution's search engine or the library's and Google. Finally, all possible tabs or drop-down menus were tested. The results of this stage indicated **136** libraries out of the 331.

Table 2: Libraries identification according criteria

Region	Number of Examined Universities	Univ.with relevant Department	Libraries with Geocoll. & GIS	Libraries with GIS serv. by Dep/Lab	No GIS
CANADA	37	37	30	2	5
USA	138	133	86	17	21
AUSTRALIA	38	38	7	3	28
NEW ZEALAND	6	6	1	0	5
AFRICA	14	14	0	1	13
MIDDLE EAST	14	13	0	2	11
ASIA	12	12	0	1	11
S.AMERICA	6	6	0	0	6
EUROPE	97	72	12	1	59
Total	**363**	**331**	**136**	**27**	**159**

As we can observe in Table 2, we located 27 GIS collections (2 in Canada, 17 in USA, 3 in Australia, 1 in Africa, 2 in Middle East and 1 in Europe) that had been developed either through the library's collaboration with a relevant department or entirely by a department or laboratory without the library's participation. At this point, these libraries were listed for future research, but were excluded from the present one.

Libraries, in which we could not have access, even if they were included in the final list, were excluded from our calculations. For example, even though we identified a geospatial academic library collection in the Middle East, the absence of translated pages into English prevented further investigation.

Table 3. Identification of the final sample of libraries
(3^{rd} stage of the research)

Region	Libr.with Geocoll & GIS serv.
CANADA	30
USA	86
AUSTRALIA	7
NEW ZEALAND	1
EUROPE	12
TOTAL	**136**

4) At the ***fourth*** stage of the research which was based on the literature and the research questions that we had set, we focused on **136** libraries that had GIS collections.

In the spreadsheet we have created, we coded the information we wanted to collect in columns while answering the following questions:

- Does the library provide geospatial collection policies?
- Does the library sustain infrastructure for the use of geospatial data?
- Does the library assist its users through information literacy programs (tutorials/guides) for the efficient use of geospatial information?
- Does the library provide the remote access for the use of geospatial data?
- Does the library have an open access software for the use of geospatial data?

It is true that academic libraries have made a great progress in the designation of their websites related to geographical information. Nevertheless, sometimes we had to look deep in their site and search several pages to find the information we had to capture.

RESULTS

According to our findings, as they are presented in Table 4, 136 libraries (30 from Canada, 86 from USA, 7 from Australia, 1 from New Zealand and 12 from Europe) (41.08%) were recorded to have geospatial collections and GIS services while 159 libraries (48.03%) have not developed such services.

Of the 136 surveyed libraries, only 24 (8 of Canada, 13 from USA, 1 from Australia, 1 from New Zealand and 1 from Europe) incorporated in their websites their policies texts, which is scientifically a small rate of 17.6 percent. Perhaps this means that the majority of libraries *do not have geospatial CDPs*.

The main features of geospatial collection development policies were: *1) General information, 2) Information regarding "Collection" 3) Information regarding "Data" 4) Information regarding "Open Access" 5) Information regarding "Cooperation"*. Each and every one of these features included a number of several topics which varied for each library.

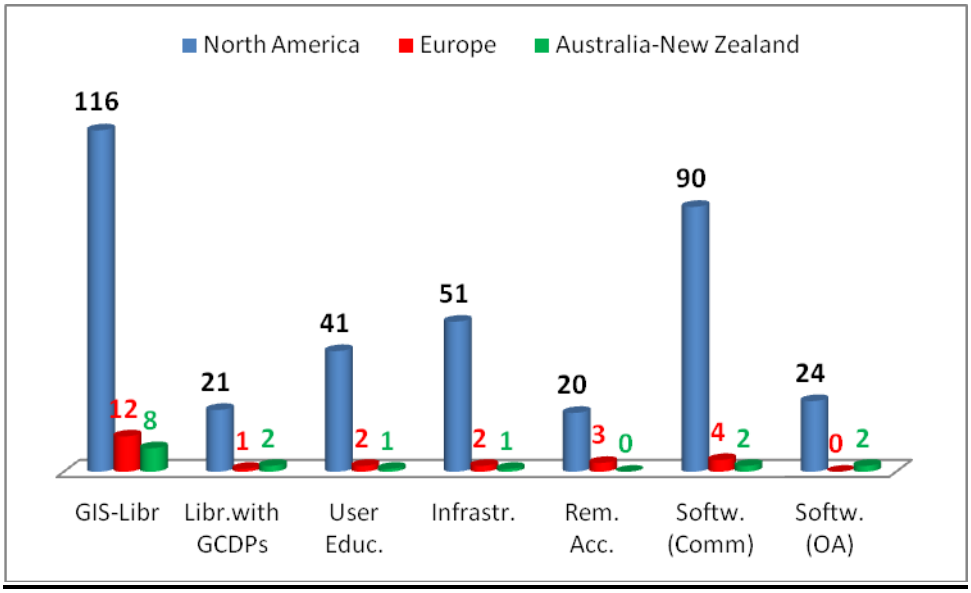
The existing *technology infrastructure* that libraries offer was mentioned in 54 libraries (14 from Canada, 37 from USA, 1 from New Zealand, 2 of Europe) for a rate of 39.7 percent. These data vary in depth and detail and are clearly associated with the features of each library to its users (e.g., Stanford University)[5]. The *remote access* is not so widespread since only in 16.9 percent of libraries details are available.

The number of 44 (32.35%) libraries (14 libraries in Canada, 27 in USA, 2 in Europe, and 1 in Australia) that declare in their web pages the user education program/interest they provide, certify library's interest for the dissemination and diffusion of the service to users.

GIS services are provided by the majority of collections and show a stable increasing trend (54/131), comparing to the results of Kinikin & Hench (2005) (22/138), Gabbaldon & Repplinger (2006) (31/103) and Garza (2006) (69/100).

The majority of libraries (70.5% which corresponds to 24 libraries in Canada, the USA 66, 1 in Australia, 1 in Zealand and 4 in Europe) declare on their page the use of a commercial software package while only 19.1 percent (9 in Canada, 15 in the U.S. and 2 in Australia) of libraries are using *open-source software.*

Fig.2: **Total research results**



DISCUSSION

Geographic variety that regulates our research dictates the categorization of the results. Thus, our findings concerning North America differ quantitatively when compared to previous surveys regarding the existence of geospatial collections and the provision of GIS services, and they add on recent info (see Table 1). Although we were confident in yielding a higher numerical result and verified the prediction of Gabaldon & Repplinger (2006) for a significant trend for geospatial collection and GIS nevertheless, our research confirms the continuous interest of libraries for geospatial collections. Authors believed that this work would extract more numerical evidence for Europe and Australia. This belief, based on their long history in map collections and in the variety of GIS applications originated by libraries in these regions, was not confirmed.

As we may see in the findings, a high differentiation between the Western and Eastern countries in sustaining geospatial collections was observed. The geospatial technology industry is an emerging sector of the African economy that is expected to see tremendous growth in the coming years (Poku-Gyamfi, 2013). We have examples of geospatial information use for growth purposes in developing countries (e.g., India, Africa)[8] in water management, environmental assessment, land use, etc.[9]. At the same time the scientific community faces constraints in several aspects required for research such as internet connectivity, knowledge productions and dissemination. These difficulties that lead to non-access to data are documented (Esanu & Ulrich, 2004, p. 83).

The lack of libraries in developing countries that sustain geospatial collections without departmental or laboratory assistant[1] can be assigned to the economic barriers as it is experienced by these countries, which prohibits even the adequate supply of basic technical infrastructure and data.

Ninety percent of the global data were produced in the last two years (Borgman, 2012) while reports[10] indicate that the next five years the market data technology will

[1] Musa & Ptijjani (2010) in their research for the implementation of GIS in Nigerian Federal Universities of Technology Libraries concluded that GIS was offered by departments while respondents indicated libraries as the most preferred location in university to provide such services.

reach 48.3 billion from 6.3 billion recorded last year, with an annual growth rate of 40.5 for years 2012-2018 (Kar, 2013). The economic, social and political value of geographic information has been indicated by researchers; its importance emerges in daily lives through the decisions we take on a wide range of issues whereas libraries, through organized collections that provide the public access to geospatial information, have their own role in information economy (Abresch e.a., 2008). Collections with geographic component, as those above, will bridge the gap between patrons in wealthier communities versus those in high levels of poverty. All citizens, should have an equal opportunity to access, retrieve and use the geographic information and libraries are the platform to implement these prescriptions.

The very low percentage of policies for geospatial data in academic libraries sustaining geospatial collections conflict with the previously mentioned bibliography, and benefits the arguments in favor of their non-necessity (Snow, 1996). Initially, these results may suggest an absence of such kind of written statement. Given the limitation of the nonexistence of previous researches in policies specific for geospatial collections, this result is similar to what earlier studies have pointed looking generally for collection development policies. Straw (2005), for instance, reported that 54 of the 124 ARL libraries (44%) had not put any collection statement on their web pages while Mangrum & Pozzebon (2012) using 41 institutional library websites obtained 23 policies. However, we should take into account that -in some cases- policy texts may not be uploaded to the library website at the time of the research, possibly for some internal reason, e.g., they are under revision. This is an unforeseen limiting factor. In other cases are not uploaded at all regardless their existence as James e.a. (2012) stated at their research. As the collection and the staff were inseparably linked (Sennyey e.a., 2009) the lack of personnel in this era of budget cuts for libraries, could be another explanation for the deficiency of policy texts. Moreover, few libraries in their statements treat geospatial collections in a way complimentary with digital material sustained in their collections. This statement is confirmed by James' e.a. (2012) research where 78% and 92.2% of the respondents accordingly, indicated that they do not have a separate policy for electronically formatted materials or for all electronic resources. This feature may need further investigation in order to clarify such objectives and creates a challenging task concerning the management of locally created research data. A research could reveal not only their possible special structure but also the organization's specified needs, which should carefully be represented in a policy statement.

Despite the methodology differences from previous studies carried out on this topic, our research highlights, when compared to the research of Kinikin & Hench (2005a) (7/22) higher response rates to user education. What we observed from our findings is the increased percentage of user education (32.35%) in comparison to policies (17.6%). User education remains one of the traditional services of the library the implementation of which is necessary to the digital environment. This justifies the presence of user education in various forms (instructions, tutorials etc.), thus indicating the willingness of the library for communication services.

Even though open-source systems are used *by* the library for diverse applications (e.g., "A Vision of Britain through Time")[11] or *for* the library, fulfilling functional requirements (Ottensmann 1997; Bishop & Mandel, 2010; Bishop e.a., 2011; Xia, 2004a; Xia, 2004b) yet they have not spread in libraries as the research indicates. This conclusion answers Donnelly's (2010) question regarding the lack of research data on the use of open systems and filling the gap in this field. Additionally, comes to confirm a recent study by Palmer & Choi (2014) who suggest that "there are many

types of OSS that are of great importance to libraries, but have received comparatively little attention in the literature", such as an OSS GIS.
It is ascertained that librarians are usually strong advocates for any significant change in library environment in order to stay viable as an information provider. Angell (2013) states that open source products offer libraries the option of customizing their own software to best meet their internal needs, as well as those of their patrons unfettered by any restrictions imposed by vendors, while Pruet & Choi argue (2013) that the implementation, promulgation, and maintenance of library information systems require an amount of coordination between information professionals and others outside of the library. For many libraries, in the era of budget cuts, this "dependence" in IT professionals may work as an obstacle for the implementation of an open source software. A further explanation for the small number of open source software that emerged from the research relies in the close connection that many libraries sustain with software vendors for the supply of geospatial data as well. This may be correlated with the high percentage of the user education programmes offered, since librarians should support their users through the multiple functionality of the proprietary software they provide.

Finally, although there are not sufficient data regarding remote access particularly to geospatial collections in libraries, our results come to confirm Troll Covey's research (2003) which reveals "that academic libraries are not meeting user needs and expectations for easy access to on line library resources turning them out dissatisfied". A variety of reasons, such as problems in IP's addresses, proxy server and virtual private network implementations, VPNs etc prevent the access to a variety of resources that in most of the times cost enough expensive to the library budget.

LIMITATIONS OF THE RESEARCH

The lack of data from those countries with null results (Africa, Middle East, South America, Asia) to research questions is an indicator for library's role. As it seems, in these countries, libraries didn't manage to ensure the diffusion of the geographic information to their patrons in an institutional setting. It cannot be seen in isolation and should be connected to their wider economic situation. This research is based on the analysis of web content that was publicly available. Consequently, content that was protected or only made available on intranets of the examined organizations are not covered in this study.

There was a great difficulty for discovering all academic libraries with geospatial collections of the world with the limitations that we had set, especially the one of academic department that correlates with GIS, a factor that made it difficult to identify them since the directories used do not sustain such kind of search/browse. Finally, the use of a different methodology in this subject e.g. a survey of libraries that are union members or federations' etc maybe would reveal much more concise results.

CONCLUSIONS

While quantitative data related to the technological infrastructure and user education are updated chronologically, the geographical expansion of research and the exploration of issues such as policies, open-source software and remote access differentiated our research.

The primary goal of the paper was to investigate whether academic libraries are communicating geographic information and GIS services to the contemporary

academic environment. According to our findings, libraries in universities which inter alia operate departments, whose curricula are based on the use of geospatial information and GIS (e.g., Geography), are located mainly in Western world. They demonstrate a constant engagement in developing geospatial collections and providing GIS services. For their efficient use, they equip their patrons with instructions, tutorials, or user- education seminars. Nevertheless, academic libraries are characterized by the limited use of CDPs, remote access to the data and the use of open source software for providing GIS services.

If related to the current global social and economic conditions the above outcomes indicate that libraries should undertake more active role in the implementation of geospatial collections and GIS services, in order to be able to sustain their value as information providers.

FUTURE WORK

Studies need to be conducted in other type of libraries (e.g., national, public) as well. Their notable involvement in developing geoservices, as the literature reveals (Jue, 1996; Kotelnikova & Kildyushevskaya 2005; Bishop e.a., 2011) is similar to academic libraries. Findings in the same topics investigated through our study will be of a great interest.

This research demonstrated a number of issues in which the librarian can play a considerable role. Librarians in universities are the key persons in the organization of new information and knowledge, creating that way a new path for access for faculty and students (Lincoln, 2010). Librarians act as mediators between information and patrons. They guide them to the best resource for retrieving information relevant to their particular goal. Consequently, librarians constitute a professional group that should be taken into account. That's why a research aiming to collect their perspectives for those key factors that promote the geo-information, would be most interesting.

Although "recent advancements in mapping technology have led to new uses for maps and a need for more of the data used to build maps" (U.S. Dept. of Labor 2012), Weimer, Agnew and Hughes (2008) in their report for MAGERT[12] identify "*the noticeable absence of an authoritative resource detailing the skills required for this type of position"* (e.g., specialized knowledge of maps, GIS and other cartographic resources, the cataloguing of, or metadata creation for these same resources). This observation, e.g. the absence of qualified librarians may be one of the main reasons that in many countries geospatial collections cannot be developed. A follow up survey in which the educational background of librarians working in academic libraries included in our research, will highlight their impact to their collections. Accordingly, special focus should be given to an exploitation of the curricula of Library Science departments all over the world. This will illustrate an overall picture of the significant skills that future librarians undertake.

Thus, further qualitative exploration of this parameter, i.e. the librarian, will possibly indicate a series of "best practices" that could be described towards the form of policies in conjunction with the open access environment.

As our research was in process we identified that most of the libraries we examined were members of co-operational schemas like UCGIS[13], or their institutions were among universities that signed for the open access movement[14]. Some others were members of SPARC[15] (Scholarly Publishing and Academic Resources Coalition), USFDLP[16] while few of those institutions belong to more than one co-operational schemas[17]. Thus, libraries seem to have not only the will for developing

synergies but also the experience for their successful outcome. It will be more than interesting to study the case of developing synergies on the locally created research data issue.

Considering the historical background of libraries to technology utilization, an issue that our research confirmed, are economic conditions that are imposed as regulators at global level and prompt users to require new flexible and effective ways of reaching information. Additionally, the development of collections from locally produced research data creates new challenges for librarians towards the integration or strengthening its relationship with the faculty and research centers / laboratories in an academic community, a fact that expands services that can be offered by libraries (Newton e.a., 2010).

Open access movement along with the increasing sophistication of technology, can create new collection and dissemination mechanisms (e.g., repositories via self deposit) for research data that librarians should take into consideration. To be successful, the above effort must be integrated into the library's planning process. The previous experience of drafting policies for digital collections is an extremely valuable assistance in the policy formulation process that will govern these new collections. Libraries in the future will collect locally created research data, and in policies that will be developed, issues regarding storage and dissemination should be carefully examined. In this case, the study of experiences from other networks like National Geospatial Digital Archive (NGDA)[18] will be very helpful.

The distribution of the plethora of geographic information is a fact. It only remains to be organized rationally, based on CDPs and using open-access system to be distributed for public use.

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Footnotes

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